Lesson Number: MS.AST.2.7

Researching Plant Growth Conditions

Middle School Food and Agricultural Literacy Curriculum

Precepts

B. Relationship

B4. Eliminate barriers in building relationships

National Standards

CS.11.01.01.b. Design an experiment to test a hypothesis.

CS.11.02.01.b. Implement an experimental design to test a formulated hypothesis.

PS.02.01.01.c. Evaluate plant responses to varied light, color, intensity and duration.

PS.02.01.02.b. Determine the optimal air, temperature and water conditions for plant growth.

NL-ENG.K-12.4 – Communication Skills

NS.5-8.1 – Science as Inquiry

NS.5-8.3 – Life Science

Student Learning Objectives

As a result of this **unit** the students will…

Discuss agricultural research.

As a result of this **lesson** the students will …

Design an agricultural research project using the scientific method.

Content Outline

I. Understand the factors that influence plant growth.

A. Amount of light

B. Temperature

C. Type of moisture applied

D. Type of seed

E. Time of day planting occurred

F. Orientation of seed

G. Type of gas exposed to the seed (i.e. carbon dioxide, oxygen)

Time

Instruction time for this lesson: 45 minutes.

Resources

National FFA Organization. (2009). LifeKnowledge Online. Retrieved July 9, 2009, from http://agedlearning.org — National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success. — Saunders, Walter L. (2003). Integrated Science Program, Utah State University. Retrieved August 20, 2009, from Exploration, Invention, Expansion Learning Cycle, Student Centered Labs for Middle School Science. Web site: http://books.google.com/books?id=p8ji6YAHrf4C&pg=PA13&lpg=PA13&dq=middle+school+seed+germination+lab&source=bl&ots=MUkXKeib2z&sig=I_FCGIqoGwavxedvaz7cMCQlhCA&hl=en&ei=xyCKSuPAEIWesgOij_3KDQ&sa=X&oi=book_result&ct=result&resnum=7#v=onepage&q=&f=false — Thomas Edison Facts. Retrieved August 20, 2009, from Wikipedia: http://wiki.answers.com/Q/How_many_times_did_Edison_try_to_invent_the_light_bulb

Tools, Equipment, and Supplies

(Depending on whether you have started this lab in a previous lesson, you may need to pre-plant the seeds prior to students attending class to follow this lesson.)
Clear plastic cups – one per student
Cotton balls – one per student
Pea seeds – one per student
Bean seeds – one per student
Radish seeds – one per student
Corn seeds – one per student
Water droppers – one per 3 to 4 kids to share
Thermometers – one per 3 to 4 kids to share
Various fluids – Enough liquid to water the amount of plants for the number of kids in your class.
Various lights (grow light, incandescent, fluorescent, halogen) – one per class
Two different pre-purchased plants
Overhead projector/transparencies
MS.AST.2.7.TM.A – one per teacher
MS.AST.2.7.TM.B – one per teacher
MS.AST.2.7.TM.C – one per teacher
MS.AST.2.7.TM.D – one per teacher
MS.AST.2.7.AS.A – one per student
MS.AST.2.7.ASSESS.A – one per student

Key Terms

Hypothesis

Test

Conclusion

II. **Design a research project using the scientific method, based on the planting of a seed.**

A. Develop a hypothesis about seed growth

B. Fill out lab sheet

C. Test hypothesis

D. Draw a conclusion about seed growth

Interest Approach

Welcome students to class and introduce today's lesson with a short story that ties in the first three steps of the scientific method.

It's great to see all of you today. Did you know that you were a born explorer? When you were one year old and having lunch in your high chair you probably were not thinking, "I'm going to experiment with these peas and see what they will do." But that's exactly what you did. Babies observe the pea's appearance, smash them, wonder what will happen when they drop them on the floor, experiment with many methods of throwing the peas and discover that when you drop things off the high chair, someone else picks them up. Babies use the scientific method every day – and they can't even talk yet. By the time kids grow up, they're experimenting with block towers, art materials, climbing bars, magnets, and letters. The scientific method is not just something we use to do experiments; it's a way of thinking that is inherent in young children's natural curiosity and their desire to learn.

Today we will be working with the scientific method just like little kids; only we'll be doing it consciously. Our experiment is working with seeds that are already planted and designing a ***test***. This ***test*** will be a result of a ***hypothesis*** that you will be making! So start thinking about what factors influence seeds and growth and let's get going!

Summary of Content and Teaching Strategies

Objective 1. Design an agricultural research project using the scientific method.

Pre-purchase two plants, flowers, greenery, etc., and place them in the front of the room for all students to see. Discuss with students how these plants grew from a seed to a full grown plant. Discuss what factors influence sprouting and growth.

In front of me are two healthy plants. What did each one of them need to get from a seed to now?

Student responses may include sun, water, nutrients, love, care, etc.

Very good. These are all factors of growth. Let's review what factors influence growth.

Display **MS.AST.2.7.TM.A** for students to see and take notes if desired.

Factors that influence growth

A. Amount of light

B. Temperature

C. Type of moisture applied

D. Type of seed

E. Time of day planting occurred

F. Orientation of seed

G. Type of gas exposed to the seed (i.e. carbon dioxide, oxygen)

What would happen if we did something out of the ordinary to a plant such as pouring Mountain Dew or milk on it? How could a wacky factor such as this change its growth?

Elicit student responses.

Know that every factor that we apply to the sprouting or growth of a plant will affect it in some way. Today each one of us will need to think outside of the box and create a ***hypothesis*** for a seed germination lab.

Researching Plant Growth Conditions

Distribute **MS.AST.2.7.AS.A** to each student.

We know that the scientific method utilizes observations that lead to a question. When we receive our lab sheets, write down the question that we will be addressing today. That question is on the overhead.

Display **MS.AST.2.7.TM.B** for students to see.

The question is: "What factors affect the amount of time it takes for a seed to germinate?"

Before we can create a ***hypothesis***, we must determine what we want to discover. We can determine this by choosing which factors we will focus on that influence the amount of time to reach germination.

Based upon the list we reviewed, decide what factors you will base your ***hypothesis*** on and write them on your lab sheet. We have 30 seconds. What questions do you have? GO.

If students need assistance choosing factors, some possible options for them could be: the amount of times a plant is watered each day, the type of water applied (tap vs. bottled), the depth of soil where the seed is planted, the temperature of the room where the seed is kept, etc.

Excellent. Now we each have chosen the factors we will use to create a ***hypothesis***. Remember that a ***hypothesis*** is an educated guess and should be written in the form of a question.

Display **MS.AST.2.7.TM.C**.

A. Hypothesis: Educated guess on how things work.

When I say GO, take two minutes to create and write a ***hypothesis*** on your lab sheets. What questions do you have? GO!

If needed, provide an example such as, "Will a lima bean sprout more quickly when given 10 ml of water three times a day and given full sun?"

Very good. The next step in the scientific method is to ***test*** your ***hypothesis***.

B. Test: Experiment to determine if your hypothesis is true or false.

Our ***test*** is to see if the factors that each of us used in our ***hypotheses*** influence the amount of time it takes for a seed to germinate.

If students have already planted their seeds from the last class then continue with student observations daily and data reported. If they have not planted seeds, utilize **MS.AST.2.7.TM.D** to start the lab. Another option is to skip the lab and discuss what would happen if you had. In this lesson, it is assumed that the teacher has already planted the seeds in the last lesson and now the test can be completed.

To ***test*** our ***hypotheses***, each day for the next five days we will apply the factors we each chose to our seed. Each day we will record our observations on our lab sheets. At the end of day five, we will complete the final step of the scientific method. What do you think the final step in the scientific method is?

Elicit student responses.

Correct! ***Conclusions***.

C. Conclusion: Formation of a theory based on observations and data.

Conclusions are the formation of a theory based on observations and data. Our conclusion will hopefully answer the question to our hypothesis. Now, tell us, does every hypothesis end up with a solid conclusion? Elicit student responses.

No, it does not. Why is that?

Elicit student responses. Student responses may include student error, creation of a bad design for a test, you may not get the conclusion you expected.

Very good. Some ***tests*** are assembled better than others and some ***tests*** are inconclusive. This is why scientists do research for many years because solid ***conclusions*** the first time are rare in research. Sometimes research can be frustrating. Who knows how many times Thomas Edison tried to make a light bulb before it worked?

Elicit student responses.

Over 1000 tries! He continually asked a question, evaluated the factors, created a ***hypothesis*** and ***tested*** it. Although this may seem like a lot of failures, it is said he never failed, instead learned over 1000 ways not to make a light bulb!

Thomas Edison continually re-evaluated his situation, made modifications and continued to

take action toward his goal of creating the light bulb. I try to do the same thing each year as a teacher. Every year, I teach mainly the same topics but instead of doing it the same way, I try to evaluate what I did, modify it, and take action to make it better.

Essentially I use the scientific method in my teaching strategies to be the best teacher I can be. Sometimes my modifications don't work, but sometimes they do or they lead me to a new idea or ***hypothesis*** that I can try again.

When is a time when you had to evaluate the situation you were in, make a change, and then act on it – maybe a play on the field or a strategy for getting your homework done?

Elicit student responses. Possible answers may include: managing homework vs. extracurricular activities, interactions with friends, relationship with parents, etc.

Good examples. We make hundreds of decisions each day and many of them we make over and over each following day. If we evaluate how we do things and make small modifications, our actions can become greater actions that may make a valuable impact on our lives and others. Think about this as you go through the day. Evaluate your decisions and actions and modify them just the way Thomas Edison did: to discover the best in everything we do.

Utilize the *Newton e-Moment*® to help deepen students' understanding of the information. Have students work individually on their questions and be sure that every student asks at least one question from their list during the share time. Post all unanswerable questions on the board and refrain from answering the question or providing clues during the share time. At the end, return to the questions that no one could answer. Provide clues, if necessary, to answer them or give them as homework or as an extra credit assignment.

The scientific method has made so many impacts to our world that we cannot list them all. To review today's lesson, create three "why" questions about our seed germination lab. The purpose of this activity is to deepen our understanding of the information and to ***test*** our classmates' ability to explain their understanding. A "why" question example would be, "Why do some plants grow better in full sunlight and some only in mild sunlight?" or "Why do you have to observe results for more than one day when a ***test*** is completed?"

Review/Summary

When I say GO, write down three "why" questions on a piece of paper. When time is up, we will go around the room and each one of you will share one of your questions with the class and see who can answer. If no one can answer the question, we will post it on the board and answer it at the end. We have three minutes. What questions do you have? GO

Allow students to write their questions.

Fantastic job today. Please turn in your "why" questions as they will be a graded assignment. The remaining questions on the board will be your homework assignment. Please write them down on a piece of paper and be ready to turn them in at the beginning of the next class period. We have three minutes. GO.

Today, we created a ***hypothesis*** based upon factors that you chose that may influence seed germination. We created a ***test*** and are in the process of trying it and making ***conclusions***. Remember to consider how evaluation and modification are the keys to success in the scientific method and how we can apply them in our own life. Thanks for participating today and being open to learning about the scientific method. We all did great!

Application

Extended Classroom Activity:

Plan a field trip to your local agriculture research station (ARS) and visit some of the research projects. ARS may be affiliated with your land grant university in your state.

FFA Activity:

Plant seeds around the school or in a garden and use techniques learned from the students' experiments to care for and grow the seeds.

SAE Activity:

Students could pursue an exploratory SAE project investigating an agriculture question and start a gardening SAE project.

Evaluation

MS.AST.2.7.ASSESS.A

Answers to Evaluation

1. Factors which may influence growth include but are not excluded to time period exposed to light, temperature, type of moisture exposed to, type of seed, time of day planting occurred, orientation of seed, type of gas exposed to seed (CO_2, O_2).
2. An educated guess on how things work.
3. A test is used to determine if a hypothesis is true or false. The test is the most important part of the scientific method as it determines the results you attain from an experiment.
4. A conclusion is the formation of a theory based on observations and data.

Factors that influence growth

1. **Amount of light**
2. **Temperature**
3. **Type of moisture applied**
4. **Type of seed**
5. **Time of day planting occurred**
6. **Orientation of seed**
7. **Type of gas exposed to the seed (i.e. carbon dioxide, oxygen)**

Question:

“What factors affect the amount of time it takes for a seed to germinate?”

Key Terms

1. **Hypothesis:** An educated guess on how something works.

2. **Test:** An experiment to determine if your hypothesis is true or false.

3. **Conclusion:** Formation of a theory based upon data and observations.

Lab Report

Question: _____

_____

_____

What factors will you use in your hypothesis? _____

_____

_____

Hypothesis: _____

_____

_____

Data Observed

Day One: _____

_____

Day Two: _____

_____

Day Three: _____

_____

Day Four: _____

_____

Day Five: _____

_____

Conclusions:

_____

_____

_____

_____

Seed Germination Lab

Procedure:

1. Tape a cotton ball containing two seeds to the inside of a plastic cup.

2. Place another cup inside the first to further secure the seeds.

3. Tape the inside cup in place.

4. Use a dropper to add liquid as needed.

5. Make observations each day

Name_____

Directions: Answer each question with complete sentences.

1. **What factors may influence growth of a seed and/or plant?**

2. **Define the term hypothesis.**

3. **Define the term test and its importance in the scientific method.**

4. **Define the term conclusion and explain why results from a conclusion are not always conclusive the first time.**